



Hawai'i Natural Energy Institute Research Highlights

Electrochemical Power Systems

Anion Exchange Membrane Fuel Cell

OBJECTIVE AND SIGNIFICANCE: Interest in anion exchange membrane fuel cells (AEMFCs) is driven by the potential for lower cost and increased durability. The goals of this project are to 1) evaluate the performance of AEMFCs with platinum group metal (PGM) content and PGM-free cathode catalysts under various operating conditions, 2) study effects of membrane electrode assemblies (MEAs) components on mass transport, water management, and durability, and 3) develop electrochemical diagnostic and analysis methods applicable for AEMFC evaluation.

BACKGROUND: Interest in AEMFCs technology (Figure 1) has been driven by possible substitution of Pt electrocatalysts by platinum metal group (PGM)-free materials, since their performance in hydrogen oxidation and oxygen reduction in alkaline media is comparable or even higher than Pt. Moreover, operation in an alkaline environment is less corrosive and can improve durability.

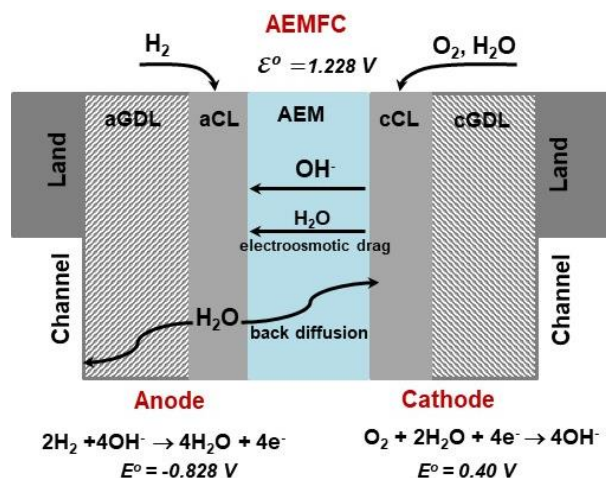


Figure 1. Schematic representation of AEMFC.

Design of MEAs for alkaline fuel cells is still in its infancy. Moreover, operation of AEMFC requires O₂ and water at the cathode, while water production happens at the anode; the situation is completely opposite compared to PEMFCs, which brings additional complexity and requirements to the MEA structure.

The main approach to improve AEMFC performance and durability is a design of catalyst layers with optimal porosity, hydroxide ion conductivity and thickness to insure development of three phase boundaries, and sufficient reagents transport, as well as adequate choice of gas diffusion layers (GDLs) for better water management. In addition, there is a lack of harmonized testing protocols and procedures and development of electrochemical diagnostics and approaches are critical for AEMFC.

PROJECT STATUS/RESULTS: Under this effort, HNEI has reached the following results:

- Established a capability to produce small size catalyst coated membranes and catalyst coated substrates, which gives opportunity for rapid evaluation of novel emerging materials available in the limited quantities;
- Established a break-in/start-up procedure after discussion with AEM manufactures and successfully tested;
- Identified critical parameters for Pt-based AEMFC MEAs, i.e., ionomer content and catalyst loading in anode and cathode; and
- Several pretreatment procedures of catalyst coated membranes were evaluated and the optimal pretreatment was identified.

Future work will include a continuation of electrochemical studies of AEMFCs with focus on MEAs reproducibility, durability, and performance.

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